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VOLUME TABLES FOR COMMERCIAL TIMBER IN THE ANTHRACITE REGION OF PENNSYLVANIA

PROGRESS REPORT

ALLEGHENY FOREST EXPERIMENT STATION

ECONOMIC SURVEY
ANTHRACITE FOREST REGION

UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

ALLEGHENY FOREST EXPERIMENT STATION
(In cooperation with the University of Pennsylvania)
Bankers Securities Building, Philadelphia, Pa.

Hardy L. Shirley, Director

Anthracite Forest Region is a convenient name for 15 counties, shown on the map on the back of this publication, which contain or surround the hard-coal deposits of Pennsylvania. The forests of this region are now badly depleted. But preliminary estimates indicate that under good management they might, in time, furnish most of the forest products and services the region requires.

The Economic Survey of this region aims to determine:

(1) what measures, and how much labor, are needed to rebuild the forests;

(2) how much labor might be employed in permanent industries based on the restored forest.

Full answers to these questions will be of utmost value both now and in the period of readjustment following the War.

This paper was prepared by

DIVISION OF FOREST ECONOMICS

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VOLUME TABLES FOR COMMERCIAL TIMBER IN THE ANTHRACITE REGION OF PENNSYLVANIA

By Clement Mesavage*

Tree volume tables are almost indispensable in obtaining reliable estimates of the amount of standing timber on a tract prior to its sale, purchase, or management. A number of such tables previously published will give accurate results if used properly, but their use in the Anthracite Region of Pennsylvania has been limited, largely because they are difficult to apply. These difficulties arise partly from the fact that the tables are based on total height or height to a fixed top diameter, and give volume of that portion of the tree trunk below a fixed top diameter. All of this portion may not be merchantable because of large branches in the top, especially in hardwoods, and serious errors in estimating merchantable volume may result from the use of these tables. The tables also assume that trees within a species or group of species have similar taper. Their authors recognize that this may not be the case, and expect adjustments to be made by comparing the tabular volumes with those of trees which have been felled or climbed on the area being cruised. Such adjustments are always expensive and time-consuming, and require a considerable amount of office work before the tables are ready for use.

The tables presented in this paper were designed to overcome these difficulties. There are only six for board feet, in three common log rules, and three for cubic feet. They give the volumes for any commercial species in this region.

Height measurements are restricted to the merchantable portion of the tree. The adjustments necessary to use the tables anywhere in this region can be made by simple ocular estimates of tree taper, instead of precise tree measurements. Although the board foot volume tables were made specifically for use in the Anthracite Forest Region, limited checks on timber elsewhere, and comparisons with volume tables acceptable for many species throughout the eastern United States, indicate that these tables may be suitable for a much wider range of species and regions.

BOARD FOOT VOLUME TABLES

The board foot volume tables are based on diameter breast high, merchantable height in 16 foot logs, and an index of tree taper known as the Girard Form Class.1/ The Girard Form Class is the ratio of the

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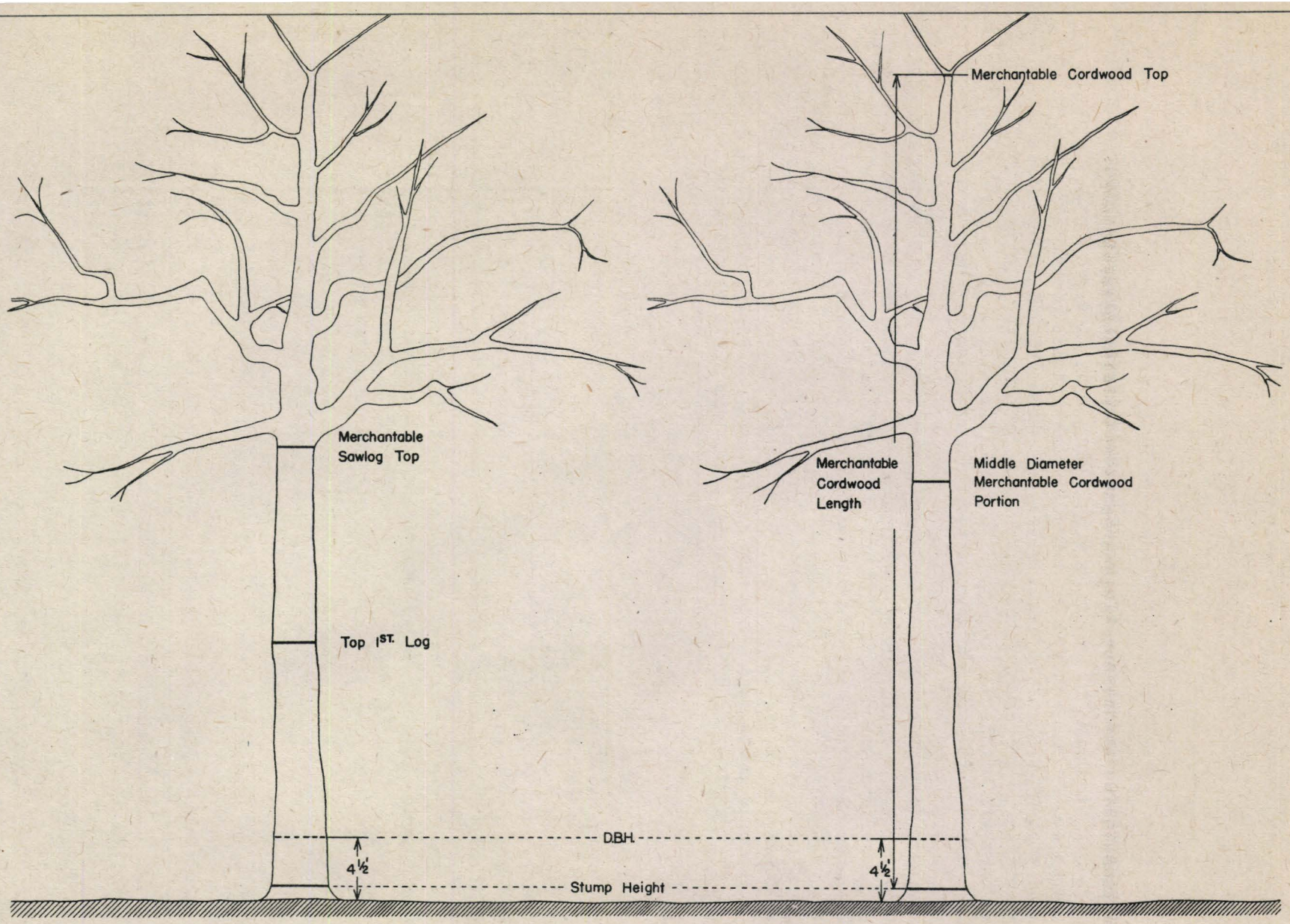
* Grateful acknowledgements are due to James W. Girard, Assistant Director, United States Forest Survey, for nearly all of the basic data used in these tables, and for his practical suggestions in their construction.

1/ Developed by James W. Girard, Assistant Director, United States Forest Survey.



$$\text{Girard Form Class} = \frac{\text{Dia. I. B. Top 1ST Log}}{\text{D.B.H.}} \times 100$$

$$\text{Girard Form Point} = \frac{\text{Mid. Dia. O. B. Merch. Cordwood}}{\text{D.B.H.}} \times 100$$

diameter inside bark at the top of the first log to the diameter breast high, outside bark, expressed as a percentage. For example, a tree having a d.b.h. of 20.0 inches, and measuring 16.0 inches inside the bark at the top of the first log, has a form class of 80. The relationship is illustrated on the opposite page. It should not be confused with the classic "form class" or "form quotient", which is the percentage relationship between d.b.h. and the diameter outside bark at a point half way between breast height and the tip of the tree. Since it defines the scaling diameter of the first log in a tree, the Girard Form Class is a true index of the volume of one-log trees. In trees containing more than one log, the only variable unaccounted for is the rate of taper in the upper log or logs. The Economic Survey determined, from measurements on many trees in the Anthracite Region, that upper log taper could be divided for all practical purposes into three groupings:

1. Low. Includes all hardwoods regardless of species
2. Medium. Includes old-growth hemlock and white pine
3. High. Includes second-growth white pine, hemlock, pitch pine, and possibly spruce

These tapers, shown for the low and medium groupings on page 11, control the scaling diameters of upper logs entering into board foot volume in the tables. Tapers in individual trees will seldom correspond exactly to the average values given, but the deviation of average tree volumes based on these tapers is usually not excessive even in a small number of trees. Diameter inside bark at top of first log in trees of various diameters and form classes are given on page 10.

Application of Board Foot Volume Tables

If considered over a wide geographical range, Girard Form Class tends to be relatively constant for a species. However, because it is sensitive to all factors which influence butt-swell, local differences in form class may be very appreciable. In using these tables, therefore, it is first necessary to determine the average form class of each species, by d.b.h. classes, in the woods being cruised. The number of trees which need to be measured for form class depends upon the variation among trees. Ordinarily, about 100 trees of each species, well distributed as to d.b.h. class and location in the woods, are sufficient. Smoothing the form class values by plotting them over D.B.H. may be necessary.

Once form class is determined, the volume in average trees of any diameter and merchantable height can be obtained from the form class tables on pages 16 to 21. Although these tables are furnished only for Form Classes 78 and 85, values for trees of any form class between 74 and 89 can be obtained by means of the chart appearing with each set of board foot volume tables. The simple instructions needed to use this chart are given on page 15.

Volume tables so constructed are "custom made", and should be discarded after the trees are cut, because there is no assurance that the remaining trees, or the trees which will grow up later, will have the same form class averages as the trees in the original stand.

If merchantable height is estimated at the same time as form class, it is easy, by plotting tree volumes as calculated from the tables over d.b.h. and smoothing with a curve, to make up a table based on diameter alone.

Ocular Estimates of Girard Form Class

Average form class may be obtained from measurements on felled or climbed trees. However, it is more practicable to obtain it ocularly from standing trees, because:

(a) The choice of sample trees is not restricted to those which can be climbed or cut, and a very representative selection can therefore be obtained without difficulty.

(b) Sample tree data can be collected very rapidly. With practice, form class can be estimated as easily as diameter. A cruiser with a "good eye" for form class, diameter, and merchantable height, can by this method prepare volume tables for sawtimber tracts in a few hours, including office work.

The ability to estimate form class can be acquired very easily. Although first attempts may be disappointing, a very good start can be made with only a few hours practice. The following training procedure is suggested:

1. Stand well away from the tree in such a position that the trunk is clearly visible from d.b.h. to the top of the first 16-foot log.

2. Study the relationship between the top d.i.b. of the first log and the d.b.h. Do not try to derive form class from ocular estimates of the actual diameters at these points.

3. Estimate the percentage relationship (form class) and record it.

4. Check the estimate by measuring the form class percentage as follows:

   (a) Using a caliper, measure and record to the nearest tenth of an inch the d.b.h. visible from the point where the ocular estimate of form class was made.

   (b) Similarly, measure and record the diameter outside bark at the top of the first log. A light ladder or tree climbers can be used to get up the tree.

(c) Obtain double bark thickness to the nearest 0.05 inches at the top of the first log, using a Swedish bark gauge, or chipping the bark with a hand axe and measuring with a scale. Subtract the double bark thickness from d.o.b.

(d) Divide the d.i.b. at the top of the first log by d.b.h. The quotient is the Girard Form Class of the tree as it appeared from the point where the ocular estimate was made.

5. Record the measured form class and compare it with the estimated form class.

6. Repeat the experiment on a number of trees. Because errors made on individual trees will soon be found to compensate, it is unnecessary to estimate form class of individual trees exactly.

Trees with elliptical cross-sections may of course have a different form class depending on which side of the tree one looks at. In actual practice, it is unnecessary to average the form class from two points of view because single measurements on a number of trees will be compensating.

A knowledge of bark thickness is of course indispensable in ocular form class determinations. Although this is best obtained through experience, the average values on page 9 will be found helpful. These measurements indicate the average double bark thickness of logs of various diameters without regard to the position of the log in the tree; they should not be used for bark thickness at breast high.

Species Form Class Averages

As previously mentioned, form class tends to be relatively constant within a species for large areas. When a high degree of accuracy is not essential, tables for the more important commercial species can be derived from the basic tables in this report by using these regional averages:

Form Class	Upper Log Taper Grouping	Species
84	Low	Beech
82	Low	Black Cherry
81	Low	Basswood, Ash, Old-growth Oaks and Yellowpoplar
81	Medium	Old-growth White Pine and Hemlock
79	Low	Second-growth Yellowpoplar
79	High	Second-growth White Pine
78	Low	Second-growth Oaks, Maple, and Birch
78	High	Spruce
76	High	Second-growth Hemlock

Merchantable Height Estimates

Estimates of merchantable height should be made carefully. In the board foot tables, the upper diameter is in no case less than 8 inches for hardwoods, or less than 6 inches in conifers, irrespective of local utilization practices, and go to a variable top diameter depending upon the upper limit of actual merchantability, which generally is the point at which the tree divides into large branches. This must be understood thoroughly or the volume tables will not be accurate. Especially with small conifers there is a tendency to consider merchantable height as extending to a point too high in the tree, because of the relatively small branches. When this is done there is extreme danger that the volume table will over-scale the tree. For example, an average 20-inch old growth White Pine with a form class of 78, and $3\frac{1}{2}$ sixteen foot logs, has a top diameter of about 10.0 inches, and a Scribner gross scale of 370 board feet. Above this point the stem tapers sharply because of branches, but by lopping the branches, 4 sixteen foot logs to a top diameter of about 7.8 inches may be cut. If the tree is scaled in sixteen foot logs (as are all trees in these tables), the sum of the scale for $3\frac{1}{2}$ sixteen foot logs is as great as for 4 logs, because a 10.0-inch top log 8 feet long scales the same as a 7.8-inch log 16 feet long. The volume table, however, shows that 4-log trees of this diameter and form class have 395 board feet, Scribner. The volume table would, therefore, overscale this tree by 25 board feet if it were estimated as 4 logs.

If a tree is scaled properly, the volume of the top log is by no means negligible. Percentage of tree volume in top 16-foot logs of trees of Form Class 78, scaled by the Scribner Decimal C Rule (curved from formula), are as follows:

	2 Log Trees		3 Log Trees		4 Log Trees	
D.B.H.	Low Upper Taper	Medium Upper Taper	Low Upper Taper	Medium Upper Taper	Low Upper Taper	Medium Upper Taper
	Percent	Percent	Percent	Percent	Percent	Percent
10	--	35	--	--	--	--
12	37	35	--	13	--	--
14	39	38	18	17	--	--
16	40	39	20	18	9	7
18	42	40	21	19	10	8
20	42	40	22	20	11	9
22	43	40	23	21	12	10
24	43	41	23	21	13	11
26	43	41	23	21	13	11
28	43	41	24	22	14	11
30	44	41	24	22	14	12

Field Check of Board Foot Volume Tables

The board foot volume tables were tested on logging jobs scattered over the Anthracite Region. The following table shows how the total measured scale, by species but without regard to size of tree, compared with the volume table estimate:

ALL TREE SIZES

Species	Trees Measured	Gross Volume, Int. 1/4 Rule		Deviation from measured scale
		Measured	Volume Table	
	Number	Bd. Ft.	Bd. Ft.	Percent
White pine	77	16,820	15,774	-6.2
Hemlock, Pitch pine	249	42,636	44,768	5.0
Oaks	61	10,467	10,618	1.4
Maples	118	45,070	44,846	-0.5
Beech	97	23,873	23,908	0.1
Birches	59	17,251	17,503	1.5
Ash, Cherry, Gum, yellowpoplar, basswood	84	14,587	14,954	2.5
Totals	745	170,704	172,371	1.0

By size of tree, the comparison is as shown on page 8.

ALL SPECIES

D.B.H.	Merchantable Height: 16 ft. to 28 ft. — Trees Number	Gross Volume, Int. 1/4 Rule — Measured Bd.Ft.	Gross Volume, Int. 1/4 Rule — Volume Table Bd.Ft.	30 ft. to 44 ft. — Trees Number	Gross Volume, Int. 1/4 Rule — Measured Bd.Ft.	Gross Volume, Int. 1/4 Rule — Volume Table Bd.Ft.	46 ft. to 64 ft. — Trees Number	Gross Volume, Int. 1/4 Rule — Measured Bd.Ft.	Gross Volume, Int. 1/4 Rule — Volume Table Bd.Ft.	All heights — Trees Number	Gross Volume, Int. 1/4 Rule — Measured Bd.Ft.	Gross Volume, Int. 1/4 Rule — Volume Table Bd.Ft.
9.0 to 12.9	132	6,300	6,539	89	9,166	8,871	8	1,093	979	229	16,559	16,389
13.0 to 16.9	39	4,396	4,399	154	24,504	25,406	57	13,289	13,221	250	42,189	43,026
17.0 to 20.9	10	2,662	2,380	50	16,447	16,732	84	32,204	32,894	144	51,313	52,006
21.0 to 24.9	3	419	360	44	18,635	18,395	44	17,936	18,850	91	36,990	37,605
25.0 to 28.9				11	8,184	8,140	12	9,770	9,510	23	17,954	17,650
29.0 to 32.9				4	2,182	2,110	3	2,433	2,550	7	4,615	4,660
33.0 to 34.9							1	1,084	1,035	1	1,084	1,035
Totals	184	13,777	13,678	352	79,118	79,654	209	77,809	79,039	745	170,704	172,371

AVERAGE DOUBLE BARK THICKNESS OF LOGS
PENNSYLVANIA ANTHRACITE REGION

D.I.B.	White Pine	Hemlock	Hickory, Red, Black & White Oaks	Chest-nut Oak	Maple and Birch	Ash, Basswood, Yellowpoplar, Black Cherry	Beech
5	0.4	0.5	0.6	1.2	0.4	0.4	0.2
6	0.4	0.5	0.6	1.3	0.4	0.5	0.2
7	0.5	0.6	0.6	1.3	0.5	0.5	0.2
8	0.5	0.7	0.7	1.4	0.5	0.6	0.3
9	0.6	0.7	0.8	1.4	0.6	0.6	0.3
10	0.6	0.8	0.8	1.4	0.7	0.6	0.4
11	0.7	0.8	0.9	1.5	0.7	0.8	0.4
12	0.7	0.9	0.9	1.5	0.7	0.8	0.4
13	0.8	1.0	0.9	1.5	0.7	0.9	0.4
14	0.8	1.0	1.0	1.6	0.8	0.9	0.5
15	0.9	1.1	1.0	1.6	0.8	1.0	0.5
16	0.9	1.1	1.0	1.7	0.8	1.0	0.5
17	1.0	1.2	1.1	1.7	0.9	1.0	0.6
18	1.0	1.3	1.1	1.8	0.9	1.1	0.6
19	1.1	1.3	1.1	1.8	1.0	1.1	0.6
20	1.2	1.3	1.2	1.8	1.0	1.2	0.7

TOP DIAMETER OF FIRST LOG,*
BY TREE DIAMETER AND FORM CLASS

	Form Class											
D.B.H.	67	68	69	70	71	72	73	74	75	76	77	78
In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
12	8.0	8.2	8.3	8.4	8.5	8.6	8.8	8.9	9.0	9.1	9.2	9.4
14	9.4	9.5	9.7	9.8	9.9	10.1	10.2	10.4	10.5	10.6	10.8	10.9
16	10.7	10.9	11.0	11.2	11.4	11.5	11.7	11.8	12.0	12.2	12.3	12.5
18	12.1	12.2	12.4	12.6	12.8	13.0	13.1	13.3	13.5	13.7	13.9	14.0
20	13.4	13.6	13.8	14.0	14.2	14.4	14.6	14.8	15.0	15.2	15.4	15.6
22	14.7	15.0	15.2	15.4	15.6	15.8	16.1	16.3	16.5	16.7	16.9	17.2
24	16.1	16.3	16.6	16.8	17.0	17.3	17.5	17.8	18.0	18.2	18.5	18.7
26	17.4	17.7	17.9	18.2	18.5	18.7	19.0	19.2	19.5	19.8	20.0	20.3
28	18.8	19.0	19.3	19.6	19.9	20.2	20.4	20.7	21.0	21.3	21.6	21.8
30	20.1	20.4	20.7	21.0	21.3	21.6	21.9	22.2	22.5	22.8	23.1	23.4

Form Class (Continued)

D.B.H.	79	80	81	82	83	84	85	86	87	88	89	90
In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
12	9.5	9.6	9.7	9.8	10.0	10.1	10.2	10.3	10.4	10.6	10.7	10.8
14	11.1	11.2	11.3	11.5	11.6	11.8	11.9	12.0	12.2	12.3	12.5	12.6
16	12.6	12.8	13.0	13.1	13.3	13.4	13.6	13.8	13.9	14.1	14.2	14.4
18	14.2	14.4	14.6	14.8	14.9	15.1	15.3	15.5	15.7	15.8	16.0	16.2
20	15.8	16.0	16.2	16.4	16.6	16.8	17.0	17.2	17.4	17.6	17.8	18.0
22	17.4	17.6	17.8	18.0	18.3	18.5	18.7	18.9	19.1	19.4	19.6	19.8
24	19.0	19.2	19.4	19.7	19.9	20.2	20.4	20.6	20.9	21.1	21.4	21.6
26	20.5	20.8	21.1	21.3	21.6	21.8	22.1	22.4	22.6	22.9	23.1	23.4
28	22.1	22.4	22.7	23.0	23.2	23.5	23.8	24.1	24.4	24.6	24.9	25.2
30	23.7	24.0	24.3	24.6	24.9	25.2	25.5	25.8	26.1	26.4	26.7	27.0

* All logs are 16.3 feet long

UPPER-LOG* TAPERS
TO LIMIT OF AVERAGE SAWTIMBER MERCHANTABILITY

Low and Medium Tapers

D.B.H.	2-Log Trees	3-Log Trees		4-Log Trees		
	Second log	Second log	Third log	Second log	Third log	Fourth log
In.	In.	In.	In.	In.	In.	In.
		Low Upper-Log Taper (Hardwoods)				
12	1.6	---	---	---	---	---
14	1.7	1.4	1.9	---	---	---
16	1.9	1.5	2.1	1.2	1.9	2.3
18	2.0	1.6	2.2	1.3	2.0	2.5
20	2.1	1.7	2.3	1.4	2.2	2.6
22	2.2	1.8	2.5	1.5	2.4	2.7
24	2.3	1.8	2.7	1.5	2.6	2.8
26	2.4	1.9	2.9	1.6	2.8	3.0
28	2.5	1.9	3.1	1.7	2.8	3.2
30	2.6	2.0	3.3	1.8	3.0	3.4
		Medium Upper-Log Taper (Old-growth White Pine and Hemlock)				
In.	In.	In.	In.	In.	In.	In.
10	1.5	---	---	---	---	---
12	1.7	1.4	2.0	---	---	---
14	1.9	1.6	2.1	---	---	---
16	2.1	1.7	2.3	1.4	1.9	2.7
18	2.3	1.9	2.4	1.5	2.1	2.9
20	2.5	2.0	2.7	1.7	2.3	3.0
22	2.7	2.2	2.9	1.8	2.6	3.2
24	2.9	2.4	3.0	1.9	2.8	3.4
26	3.1	2.6	3.2	2.0	3.0	3.7
28	3.3	2.7	3.3	2.1	3.2	3.8
30	3.5	2.9	3.5	2.2	3.5	4.0

* All logs are 16.3 feet long

Basic data from James W. Girard, 1940.
Mesavage, 1942.

SCALE IN BOARD FEET OF 16-FOOT LOGS 1/

International $\frac{1}{4}$-inch Rule

Computed from Formula $V = 0.796D^2 - 1.375D - 1.230$

Top diameter of log, inside both barks										
	Tenths of Inches									
Inches	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
6	19	20	21	22	23	23	24	25	26	27
7	28	29	30	31	32	33	34	35	36	38
8	39	40	41	42	43	45	46	47	48	50
9	51	52	53	55	56	58	59	60	62	63
10	65	66	68	69	71	72	74	75	77	78
11	80	82	83	85	87	88	90	92	93	95
12	97	99	100	102	104	106	108	110	112	113
13	115	117	119	121	123	125	127	129	131	133
14	136	138	140	142	144	146	148	151	153	155
15	157	160	162	164	166	169	171	173	176	178
16	181	183	185	188	190	193	195	198	200	203
17	205	208	211	213	216	218	221	224	226	229
18	232	235	237	240	243	246	249	251	254	257
19	260	263	266	269	272	275	278	281	284	287
20	290	293	296	299	302	305	308	311	315	318
21	321	324	327	331	334	337	340	344	347	350
22	354	357	361	364	367	371	374	378	381	385
23	388	392	395	399	402	406	410	413	417	421
24	424	428	432	435	439	443	447	450	454	458
25	462	466	470	473	477	481	485	489	493	497
26	501	505	509	513	517	521	525	530	534	538
27	542	546	550	554	559	563	567	571	576	580
28	584	589	593	597	602	606	611	615	619	624
29	628	633	637	642	646	651	655	660	665	669
30	674	679	683	688	693	697	702	707	712	716

1/ Compiled by E. T. Hawes, Region 8, U. S. Forest Service

This table to be used for purposes of volume table construction only.

V = volume in board feet
D = diameter of log at small end, inside bark, in inches

SCALE IN BOARD FEET OF 16-FOOT LOGS 1/

Scribner Decimal C Rule
Computed from Formula, curved and read to nearest board foot

Formula $V = 0.79D^2 - (2D + 4)$

	Top diameter of log, inside both barks									
	Tenths of Inches									
Inches	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.
6	12	13	14	15	16	16	17	18	19	20
7	21	22	23	23	24	25	26	27	28	30
8	31	32	33	34	35	36	37	38	40	41
9	42	43	44	46	47	48	50	51	52	54
10	55	56	58	59	61	62	64	65	67	68
11	70	71	73	74	76	77	79	81	82	84
12	86	87	89	91	93	94	96	98	100	102
13	104	105	107	109	111	113	115	117	119	121
14	123	125	127	129	131	133	135	137	139	142
15	144	146	148	150	153	155	157	159	162	164
16	166	169	171	173	176	178	180	183	185	188
17	190	193	195	198	200	203	206	208	211	213
18	216	219	221	224	227	229	232	235	238	240
19	243	246	249	252	255	257	260	263	266	269
20	272	275	278	281	284	287	290	293	296	299
21	302	306	309	312	315	318	321	325	328	331
22	334	338	341	344	348	351	354	358	361	364
23	368	371	375	378	382	385	389	392	396	399
24	403	407	410	414	418	421	425	429	432	436
25	440	444	447	451	455	459	463	466	470	474
26	478	482	486	490	494	498	502	506	510	514
27	518	522	526	530	534	538	543	547	551	555
28	559	564	568	572	576	581	585	589	594	598
29	602	607	611	616	620	624	629	633	638	642
30	647	652	656	661	665	670	675	679	684	688

1/ From "Timber Cruising" - James W. Girard and Suren R. Gevorkiantz

This table to be used for purposes of volume table construction only.

V = volume in board feet
D = diameter of log at small end, inside bark, in inches

SCALE IN BOARD FEET OF 16-FOOT LOGS 1/

Doyle Rule

Computed from Formula $V = \frac{(D-4)^2 \times L}{16}$

Top diameter of log, inside both barks										
	Tenths of Inches									
Inches	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.
6	4	4	5	5	6	6	7	7	8	8
7	9	10	10	11	12	12	13	14	14	15
8	16	17	18	18	19	20	21	22	23	24
9	25	26	27	28	29	30	31	32	34	35
10	36	37	38	40	41	42	44	45	46	48
11	49	50	52	53	55	56	58	59	61	62
12	64	66	67	69	71	72	74	76	77	79
13	81	83	85	86	88	90	92	94	96	98
14	100	102	104	106	108	110	112	114	117	119
15	121	123	125	128	130	132	135	137	139	142
16	144	146	149	151	154	156	159	161	164	166
17	169	172	174	177	180	182	185	188	190	193
18	196	199	202	204	207	210	213	216	219	222
19	225	228	231	234	237	240	243	246	250	253
20	256	259	262	266	269	272	276	279	282	286
21	289	292	296	299	303	306	310	313	317	320
22	324	328	331	335	339	342	346	350	353	357
23	361	365	369	372	376	380	384	388	392	396
24	400	404	408	412	416	420	424	428	433	437
25	441	445	449	454	458	462	467	471	475	480
26	484	488	493	497	502	506	511	515	520	524
27	529	534	538	543	548	552	557	562	566	571
28	576	581	586	590	595	600	605	610	615	620
29	625	630	635	640	645	650	655	660	666	671
30	676	681	686	692	697	702	708	713	718	724

1/ Compiled by Southern Forest Experiment Station, 1934.

This table to be used for purposes of volume table construction only.

V = volume in board feet
D = diameter of log at small end, inside bark, in inches
L = length of log in feet

INSTRUCTIONS FOR USING FORM CLASS CHART

The chart appearing on this page was designed to eliminate separate board foot volume tables for each form class. With its use, tree volumes can be obtained for trees having a form class higher or lower than those for which basic tables are presented. Within limits, an increase or decrease in Girard Form Class represents a uniform increase or decrease in the volume of the trees. Average changes in volume due to changes in form class are:

Form Class Increase	Change in Volume	Form Class Decrease	Change in Volume
1%	3.0%	1%	-2.8%
2%	6.1%	2%	-5.8%
3%	9.4%	3%	-8.7%
4%	12.8%	4%	-11.7%

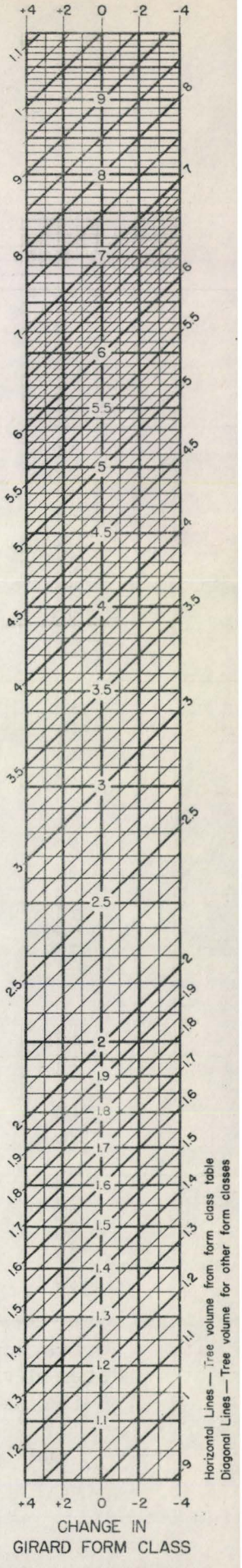
Thus a tree which has a Form Class 81 will have a volume 9.4% higher than a Form Class 78 tree of the same species or species group, diameter, and merchantable height. Assuming the volume of a Form Class 78 tree to be 500 board feet, the Form Class 81 volume can be determined directly from the chart as follows:

1. Locate the vertical line representing +3% change in form class.

2. Follow this line to its intersection with the horizontal line labelled "5", which in this case represents "500".

3. The diagonal line passing through this intersection is "548", which rounded out to nearest 5 feet is "550", the board foot volume desired.

Similarly, in determining the volume of a Form Class 82 tree, its volume would first be determined from the pertinent Form Class 85 volume table and reduced to Form Class 82 on the chart. If the Form Class 85 volume were 500 board feet, the Form Class 82 would be obtained by following the vertical line representing -3% change in form class. The diagonal passing through the intersection of this vertical line and the horizontal line representing 500 board feet is about 460 board feet.


+4 +2 0 -2 -4
+4 +2 0 -2 -4
CHANGE IN
GIRARD FORM CLASS
Horizontal Lines — Tree volume from form class table
Diagonal Lines — Tree volume for other form classes

TREE VOLUMES IN BOARD FEET, HARDWOODS

by D.B.H. and Number of Logs

Girard Form Class 78

D.B.H.	Number of 16-foot logs						
	1	1½	2	2½	3	3½	4
Inches	Bd.Ft.	Bd.Ft.	Bd.Ft.	Bd.Ft.	Bd.Ft.	Bd.Ft.	Bd.Ft.
			International ¼ Log Rule*				
12	56	74	92	---	---	---	---
14	78	105	130	150	170	---	---
16	106	145	180	210	235	255	275
18	136	185	235	270	310	335	360
20	171	235	295	345	395	430	465
22	211	295	370	430	490	540	580
24	251	350	440	520	595	655	705
26	299	420	530	625	710	780	840
28	347	490	615	735	835	920	990
30	402	570	715	850	970	1065	1155
			Scribner Decimal C Log Rule*				
12	47	61	75	---	---	---	---
14	68	90	110	130	145	---	---
16	94	130	160	185	205	225	240
18	123	170	210	245	275	300	320
20	157	215	270	315	360	395	415
22	195	270	340	400	450	495	525
24	235	330	410	485	550	605	645
26	281	395	495	585	665	730	780
28	328	460	580	685	780	860	925
30	382	535	680	805	915	1005	1080
			Doyle Log Rule*				
12	29	36	43	---	---	---	---
14	48	60	75	85	90	---	---
16	72	95	115	130	145	155	165
18	100	135	165	190	210	225	240
20	135	185	225	260	290	315	330
22	174	240	295	340	385	415	440
24	216	295	370	430	485	530	565
26	266	370	460	540	605	660	705
28	317	440	550	650	735	805	855
30	376	525	660	775	880	960	1025

Gross board foot volume in 16-foot logs above stump to point where the stem divides into large branches. Top diameter variable, not less than 8 inches inside bark. Compiled from taper tables. Mesavage, 1942.

* Note log rules pages 12, 13, 14.

TREE VOLUMES IN BOARD FEET, HARDWOODS

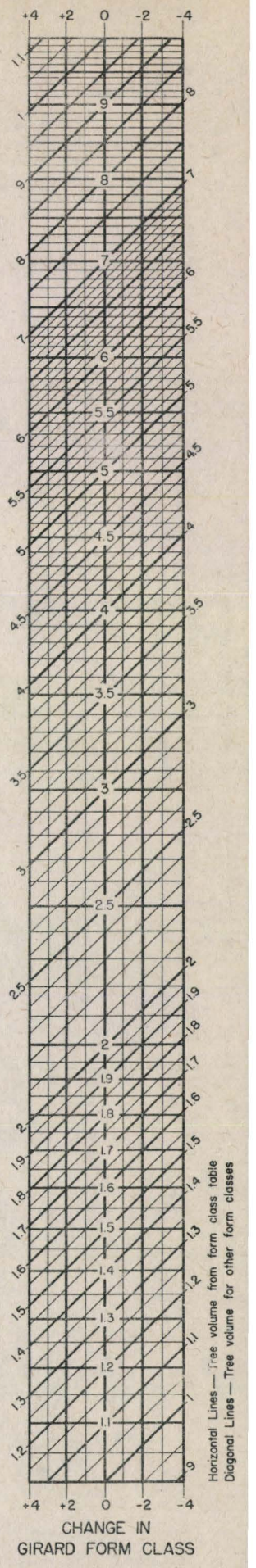
by D.B.H. and Number of Logs

Girard Form Class 85

D.B.H.	Number of 16-foot logs						
	1	1½	2	2½	3	3½	4
Inches	Bd.Ft.	Bd.Ft.	Bd.Ft.	Bd.Ft.	Bd.Ft.	Bd.Ft.	Bd.Ft.
	International ¼ Log Rule*						
12	68	91	115	---	---	---	---
14	95	130	165	195	215	---	---
16	127	175	220	260	290	320	345
18	164	225	285	340	380	425	455
20	205	285	360	425	485	535	575
22	251	355	445	525	600	665	715
24	302	425	535	640	730	805	870
26	357	500	640	760	865	960	1035
28	417	585	750	895	1020	1135	1225
30	481	680	865	1035	1185	1310	1420
	Scribner Decimal C Log Rule*						
12	58	77	95	---	---	---	---
14	84	110	140	165	185	---	---
16	115	155	195	225	255	285	305
18	150	205	260	305	345	380	405
20	190	265	330	395	445	490	525
22	235	335	415	490	555	610	655
24	284	400	505	600	680	755	810
26	338	475	600	715	815	900	970
28	396	560	710	850	965	1070	1155
30	459	650	825	985	1120	1240	1340
	Doyle Log Rule*						
12	38	49	59	---	---	---	---
14	62	85	100	115	125	---	---
16	92	125	150	175	195	210	225
18	128	175	215	250	280	305	320
20	169	230	290	335	380	415	440
22	216	300	370	435	490	535	575
24	269	375	470	555	625	685	730
26	328	455	575	675	765	840	900
28	392	545	690	820	930	1025	1100
30	462	650	820	975	1105	1220	1305

Gross board foot volume in 16-foot logs above stump to point where the stem divides into large branches. Top diameter variable, not less than 8 inches inside bark. Compiled from taper tables. Mesavage, 1942.

* Note log rules pages 12, 13, 14.


+4 +2 0 -2 -4
CHANGE IN
GIRARD FORM CLASS
Horizontal Lines — Tree volume from form class table
Diagonal Lines — Tree volume for other form classes

TREE VOLUMES IN BOARD FEET,
OLD-GROWTH WHITE PINE AND HEMLOCK

Girard Form Class 78

D.B.H.	Number of 16-foot logs						
	1	1½	2	2½	3	3½	4
Inches	Bd.Ft.	Bd.Ft.	Bd.Ft.	Bd.Ft.	Bd.Ft.	Bd.Ft.	Bd.Ft.
			International ¼ Log Rule*				
10	36	47	58	---	---	---	---
12	56	75	91	105	115	---	---
14	78	105	130	150	165	---	---
16	106	145	175	205	230	250	265
18	136	185	230	265	295	325	345
20	171	230	290	335	375	410	440
22	211	285	355	415	465	510	550
24	251	340	425	495	560	615	660
26	299	405	510	595	670	740	795
28	347	475	595	695	785	865	930
30	402	555	690	805	910	1000	1080
			Scribner Decimal C Log Rule*				
10	28	36	43	50	---	---	---
12	47	62	74	85	90	---	---
14	68	91	110	125	135	---	---
16	94	125	155	175	195	215	225
18	123	165	205	235	260	290	305
20	157	210	260	305	340	370	395
22	195	265	330	380	425	465	500
24	235	320	395	460	515	565	605
26	281	385	475	555	620	685	735
28	328	450	555	655	735	810	865
30	382	525	650	765	860	940	1015
			Doyle Log Rule*				
10	14	17	19	---	---	---	---
12	29	36	43	48	49	---	---
14	48	61	73	80	86	---	---
16	72	77	115	130	140	150	155
18	100	135	160	180	200	215	225
20	135	180	220	250	275	295	310
22	174	230	285	325	360	385	410
24	216	290	355	410	455	495	525
26	266	360	440	505	565	610	655
28	317	425	525	610	685	745	795
30	376	515	630	730	815	890	955

Gross board foot volume in 16-foot logs above stump to point where the stem divides into large branches. Top diameter variable, not less than 6 inches inside bark. Compiled from taper tables. Mesavage, 1942.

* Note log rules pages 12, 13, 14.

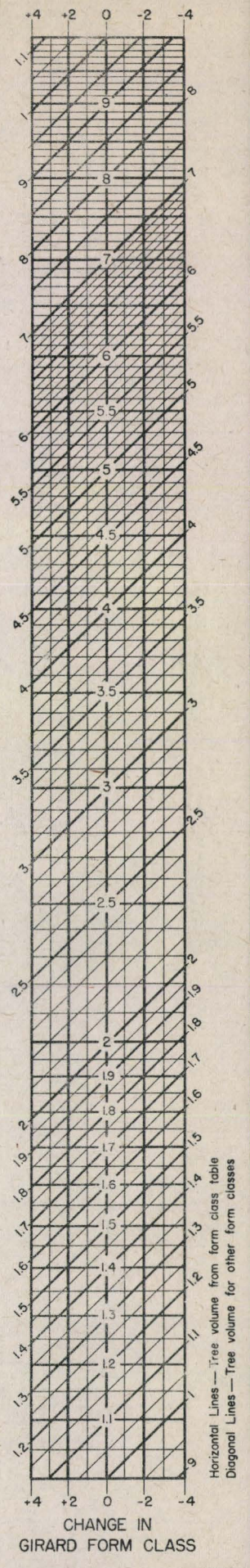
TREE VOLUMES IN BOARD FEET, OLD-GROWTH WHITE PINE AND HEMLOCK

Girard Form Class 85

D.B.H.	Number of 16-foot logs						
	1	1½	2	2½	3	3½	4
Inches	Bd.Ft.	Bd.Ft.	Bd.Ft.	Bd.Ft.	Bd.Ft.	Bd.Ft.	Bd.Ft.
			International ¼ Log Rule*				
10	45	59	73	---	---	---	---
12	68	95	115	130	140	---	---
14	95	130	160	185	205	---	---
16	127	175	215	250	280	305	330
18	164	225	280	325	365	405	435
20	205	280	350	410	465	510	550
22	251	345	430	505	570	630	680
24	302	415	520	610	690	765	825
26	357	490	615	725	820	910	980
28	417	575	720	850	965	1070	1160
30	481	665	835	990	1120	1240	1340
			Scribner Decimal C Log Rule*				
10	36	47	57	---	---	---	---
12	58	76	94	105	115	---	---
14	84	110	140	160	175	---	---
16	115	155	190	220	250	270	290
18	150	200	255	295	330	360	390
20	190	255	325	375	425	460	500
22	235	320	400	465	530	575	625
24	284	385	485	565	645	705	765
26	338	460	580	675	770	840	915
28	396	540	685	800	915	1000	1085
30	459	625	795	925	1060	1160	1265
			Doyle Log Rule*				
10	20	25	29	---	---	---	---
12	38	48	58	65	69	---	---
14	62	84	100	110	120	---	---
16	92	125	150	170	185	200	210
18	128	170	210	240	265	285	305
20	169	225	280	325	360	390	415
22	216	290	360	420	465	505	540
24	269	360	450	525	585	640	685
26	328	450	555	645	720	785	845
28	392	540	665	775	875	955	1030
30	462	635	785	920	1035	1135	1225

Gross board foot volume in 16-foot logs above stump to point where the stem divides into large branches. Top diameter variable, not less than 6 inches inside bark. Compiled from taper tables. Mesavage, 1942.

* Note log rules pages 12, 13, 14.


+4 +2 0 -2 -4
CHANGE IN GIRARD FORM CLASS
Horizontal Lines — Tree volume from form class table
Diagonal Lines — Tree volume for other form classes

TREE VOLUMES IN BOARD FEET,
SECOND-GROWTH WHITE PINE AND HEMLOCK

Girard Form Class 78

D.B.H.	Number of 16-foot logs						
	1	1½	2	2½	3	3½	4
Inches	Bd.Ft.	Bd.Ft.	Bd.Ft.	Bd.Ft.	Bd.Ft.	Bd.Ft.	Bd.Ft.
	International ¼ Log Rule*						
10	36	48	57	---	---	---	---
12	56	75	90	100	110	---	---
14	78	105	130	145	160	---	---
16	106	140	170	200	225	240	255
18	136	180	225	255	280	305	330
20	171	225	285	320	355	390	415
22	211	280	340	395	440	485	520
24	251	335	410	470	525	580	620
26	299	400	490	565	630	695	750
28	347	470	575	665	740	815	875
30	402	550	670	770	855	940	1010
	Scribner Decimal C Log Rule*						
10	28	35	42	---	---	---	---
12	47	59	74	80	86	---	---
14	68	90	110	120	125	---	---
16	94	125	150	170	185	200	210
18	123	165	200	225	245	275	290
20	157	205	250	290	320	350	375
22	195	260	315	365	405	445	475
24	235	310	380	435	480	530	565
26	281	370	450	520	580	635	690
28	328	435	530	615	690	755	810
30	382	510	620	720	810	885	955
	Doyle Log Rule*						
10	14	16	18	---	---	---	---
12	29	36	42	---	---	---	---
14	48	60	71	78	82	---	---
16	72	95	115	125	135	140	145
18	100	130	155	175	190	205	210
20	135	175	210	240	260	280	290
22	174	225	270	310	335	365	380
24	216	285	340	390	425	465	490
26	266	350	420	475	530	575	610
28	317	415	500	575	640	695	740
30	376	495	600	690	760	830	890

Gross board foot preliminary table volume in 16-foot logs above stump to point where the stem divides into large branches. Top diameter variable, not less than 6 inches inside bark. Mesavage, 1942.

* Note log rules pages 12, 13, 14.

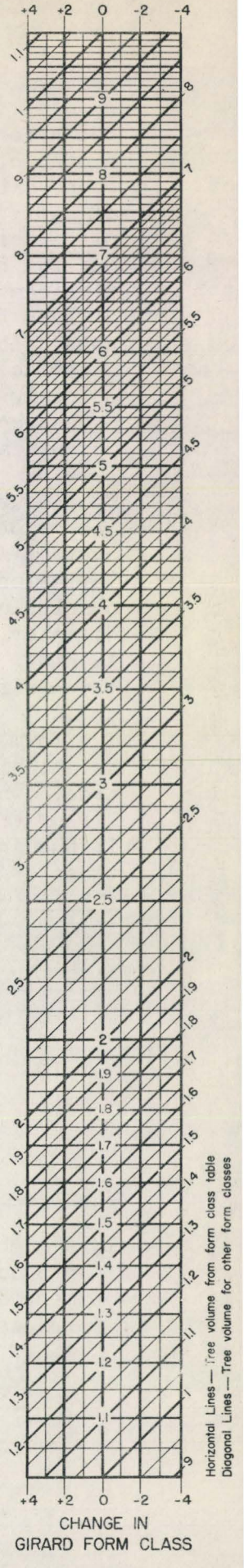
TREE VOLUMES IN BOARD FEET,
SECOND-GROWTH WHITE PINE AND HEMLOCK

Girard Form Class 85

D.B.H.	Number of 16-foot logs						
	1	1½	2	2½	3	3½	4
Inches	Bd.Ft.	Bd.Ft.	Bd.Ft.	Bd.Ft.	Bd.Ft.	Bd.Ft.	Bd.Ft.
				International ¼ Log Rule*			
10	45	60	71	---	---	---	---
12	68	93	115	---	---	---	---
14	95	125	155	180	195	---	---
16	127	170	210	240	270	295	315
18	164	220	275	315	350	390	415
20	205	275	340	395	445	490	525
22	251	335	415	480	540	595	645
24	302	405	505	580	650	720	780
26	357	480	590	690	780	860	930
28	417	560	690	810	915	1015	1100
30	481	655	805	945	1060	1170	1265
				Scribner Decimal C Log Rule*			
10	36	46	52	---	---	---	---
12	58	78	92	105	110	---	---
14	84	110	140	155	165	---	---
16	115	155	185	220	245	265	275
18	150	200	250	285	315	350	375
20	190	255	315	360	405	445	475
22	235	315	385	450	505	555	595
24	284	380	465	540	610	665	720
26	338	455	560	650	730	805	865
28	396	540	660	770	865	950	1020
30	459	625	765	895	1005	1105	1195
				Doyle Log Rule*			
10	20	---	---	---	---	---	---
12	38	49	57	---	---	---	---
14	62	83	100	110	115	---	---
16	92	120	150	165	175	190	195
18	128	165	205	235	250	275	290
20	169	220	270	305	340	370	390
22	216	285	350	400	440	475	505
24	269	355	430	495	550	600	645
26	328	435	535	615	680	745	795
28	392	525	640	735	825	900	965
30	462	615	750	865	970	1065	1150

Gross board foot preliminary table volume in 16-foot logs above stump to point where the stem divides into large branches. Top diameter variable, not less than 6 inches inside bark. Mesavage, 1942.

*Note log rules pages 12, 13, 14.


+4 +2 0 -2 -4
CHANGE IN
GIRARD FORM CLASS
Horizontal Lines — Tree volume from form class table
Diagonal Lines — Tree volume for other form classes

CUBIC FOOT VOLUME TABLES

Cubic foot volume tables are generally useful in determining the amount of wood in a tree which is suitable for mine props or other round material. The original volume determinations are made in terms of cubic feet, and are then converted to weight, or cords, by the use of converting factors.1/ Such products need not have the size or quality necessary in saw timber, and for this reason, tree utilization can be more complete. If the taper of the merchantable portion of such trees can be considered to approach that of a frustum of a cone, (it more nearly approaches that of a frustum of a paraboloid), a simple means of determining the cubic foot contents of a tree is to multiply the length of the merchantable portion of the tree by the cross-sectional area at a point half way between the stump and the merchantable top. This is known as Huber's Formula ($V = L \times A_{\frac{1}{2}}$).

By the use of this formula, an approximate cubic foot volume table can be prepared by determining the average merchantable height and average middle diameter of trees for each d.b.h. class of a species. Variation in taper is reflected in the middle diameter of the merchantable portion of the tree. The percentage relationship of this diameter, when measured outside bark, to the diameter at breast high is known as the Girard Form Point, which should not be confused with the Girard Form Class. See illustration, page 2.

The form point of individual trees will vary widely with the diameter breast high and the top diameter of the merchantable portion of the tree. On the average, however, the form point is smaller among the larger trees. According to James W. Girard, the form points of trees in the Anthracite Region are for all practical purposes similar to those of Southern pines, which he found to vary about as follows:

	High Form		Average Form		Low Form	
D.B.H.	Form Point	Middle Diameter	Form Point	Middle Diameter	Form Point	Middle Diameter
6	85	5.1	83	5.0	81	4.95
8	83	6.7	81	6.5	79	6.3
10	81	8.1	79	7.9	77	7.7
12	79	9.5	77	9.2	75	9.0
14	77	10.8	75	10.5	73	10.2
16	75	12.0	73	11.7	71	11.4
18	73	13.1	71	12.8	69	12.4

1/ A number of converting factors useful for the measurement of wood products in the Anthracite Region have been prepared by the Experiment Station and will be published later, but are now available on request.

These relationships are based on a variable merchantable cordwood top diameter which in no case is less than 4 inches, outside bark. The cubic tables on pages 24 to 26 have been compiled with these form point percentages as a base. In applying them, it is necessary only to determine which of the three tables will most nearly fit each species in the area being cruised. Actual measurements of form point can be made either on felled trees or on windfalls, but, like form class, the form point of a tree can be estimated ocularly after some practice. The ocular method is preferable because of its speed and flexibility in the choice of sample trees.

When a high degree of accuracy is not essential, use of the tables based on "average" form point will be found to give reasonable approximation for all species in this region.

TREE VOLUMES IN CUBIC FEET, INCLUDING BARK, ALL SPECIES

by D.B.H. and Merchantable Length

TREES OF ABOVE-AVERAGE FORM

Form Point	D.B.H.	Merchantable length of stem in feet														Middle Diameter
	Inches	12	16	20	24	28	32	36	40	44	48	52	56	60	64	Inches
		Cubic Feet														
85	6	1.7	2.3	2.8	3.4	4.0	4.5	5.1								5.1
83	8		3.9	4.9	5.9	6.9	7.8	8.8	9.8	10.8	11.8					6.7
81	10			7.2	8.6	10.0	11.5	12.9	14.3	15.8	17.2	18.6	20.0	21.5		8.1
79	12				11.8	13.8	15.7	17.7	19.7	21.7	23.6	25.6	27.6	29.5	31.5	9.5
77	14					17.8	20.4	22.9	25.4	28.0	30.5	33.1	35.6	38.2	40.7	10.8
75	16						25.1	28.3	31.4	34.5	37.7	40.8	44.0	47.1	50.2	12.0

Top utilization assumed to average approximately 5 inches outside bark, varying from 3.8 inches to 6 inches.

James W. Girard

Compiled by Southern Forest Experiment Station

TREE VOLUMES IN CUBIC FEET, INCLUDING BARK, ALL SPECIES

by D.B.H. and Merchantable Length

TREES OF AVERAGE FORM

Form Point	D.B.H.	Merchantable length of stem in feet														Middle Diameter
	Inches	12	16	20	24	28	32	36	40	44	48	52	56	60	64	Inches
		Cubic Feet														
83	6	1.6	2.1	2.7	3.2	3.8	4.3	4.8								4.95
81	8		3.7	4.6	5.5	6.4	7.4	8.3	9.2	10.1	11.0					6.50
79	10			6.8	8.2	9.6	10.9	12.3	13.7	15.0	16.4	17.8	19.2	20.5		7.92
77	12				11.2	13.0	14.9	16.7	18.6	20.5	22.3	24.2	26.0	27.9	29.8	9.23
75	14					16.9	19.3	21.7	24.1	26.5	28.9	31.3	33.7	36.1	38.5	10.51
73	16						23.9	26.9	29.9	32.9	35.9	38.9	41.9	44.9	47.9	11.71

Top utilization assumed to average approximately 5 inches outside bark, varying from 3.8 inches to 6 inches.

James W. Girard

Compiled by Southern Forest Experiment Station

TREE VOLUMES IN CUBIC FEET, INCLUDING BARK, ALL SPECIES

by D.B.H. and Merchantable Length

TREES OF BELOW-AVERAGE FORM

Form Point	D.B.H.	Merchantable length of stem in feet														Middle Diameter
	Inches	12	16	20	24	28	32	36	40	44	48	52	56	60	64	Inches
		Cubic Feet														
81	6	1.6	2.1	2.6	3.1	3.7	4.2	4.7								4.9
79	8		3.5	4.3	5.2	6.0	6.9	7.8	8.6	9.5	10.4					6.3
77	10			6.5	7.8	9.0	10.3	11.6	12.9	14.2	15.5	16.8	18.1	19.4		7.7
75	12				10.6	12.4	14.1	15.9	17.7	19.4	21.2	23.0	24.8	26.5	28.3	9.0
73	14					15.9	18.1	20.4	22.7	24.9	27.2	29.5	31.8	34.0	36.3	10.2
71	16						22.7	25.5	28.4	31.2	34.0	36.9	39.7	42.5	45.4	11.4

Top utilization assumed to average approximately 5 inches outside bark, varying from 3.8 inches to 6 inches.

James W. Girard

Compiled by Southern Forest Experiment Station

AREA OF CIRCLES IN SQUARE FEET (BASAL AREA TABLE) 1/

Diameter	Diameter - tenths of inches										Diameter
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	
	Area - square feet										
Inches											Inches
						0.001	0.002	0.003	0.003	0.004	
1	0.005	0.007	0.008	0.009	0.011	0.012	0.014	0.016	0.018	0.020	1
2	.022	.024	.026	.029	.031	.034	.037	.040	.043	.046	2
3	.049	.052	.056	.059	.063	.067	.071	.075	.079	.083	3
4	.087	.092	.096	.101	.106	.110	.115	.120	.126	.131	4
5	.136	.142	.147	.153	.159	.165	.171	.177	.183	.190	5
6	.196	.203	.210	.216	.223	.230	.238	.245	.252	.260	6
7	.267	.275	.283	.291	.299	.307	.315	.323	.332	.340	7
8	.349	.358	.367	.376	.385	.394	.403	.413	.422	.432	8
9	.442	.452	.462	.472	.482	.492	.503	.513	.524	.535	9
10	.545	.556	.567	.579	.590	.601	.613	.624	.636	.648	10
11	.660	.672	.684	.696	.709	.721	.734	.747	.759	.772	11
12	.785	.799	.812	.825	.839	.852	.866	.880	.894	.908	12
13	.922	.936	.950	.965	.979	.994	1.009	1.024	1.039	1.054	13
14	1.069	1.084	1.100	1.115	1.131	1.147	1.163	1.179	1.195	1.211	14
15	1.227	1.244	1.260	1.277	1.294	1.310	1.327	1.344	1.362	1.379	15
16	1.396	1.414	1.431	1.449	1.467	1.485	1.503	1.521	1.539	1.558	16
17	1.576	1.595	1.614	1.632	1.651	1.670	1.689	1.709	1.728	1.748	17
18	1.767	1.787	1.807	1.827	1.847	1.867	1.887	1.907	1.928	1.948	18
19	1.969	1.990	2.011	2.032	2.053	2.074	2.095	2.117	2.138	2.160	19
20	2.182	2.204	2.226	2.248	2.270	2.292	2.315	2.337	2.360	2.382	20
21	2.405	2.428	2.451	2.474	2.498	2.521	2.545	2.568	2.592	2.616	21
22	2.640	2.664	2.688	2.712	2.737	2.761	2.786	2.810	2.835	2.860	22
23	2.885	2.910	2.936	2.961	2.986	3.012	3.038	3.064	3.089	3.115	23
24	3.142	3.168	3.194	3.221	3.247	3.274	3.301	3.328	3.355	3.382	24

Diameter	Area	Diameter	Area	Diameter	Area	Diameter	Area	Diameter	Area
Inches	Sq.Ft.	Inches	Sq.Ft.	Inches	Sq.Ft.	Inches	Sq.Ft.	Inches	Sq.Ft.
25	3.409	32	5.585	39	8.296	46	11.541	53	15.321
26	3.687	33	5.940	40	8.727	47	12.048	54	15.904
27	3.976	34	6.305	41	9.168	48	12.566	55	16.499
28	4.276	35	6.681	42	9.621	49	13.095	56	17.104
29	4.587	36	7.069	43	10.085	50	13.635	57	17.721
30	4.909	37	7.467	44	10.559	51	14.186	58	18.348
31	5.241	38	7.876	45	11.045	52	14.748	59	18.986

1/ Revised and checked by Southern Forest Experiment Station with Basal Area Table, "Forest Mensuration", by H. H. Chapman.

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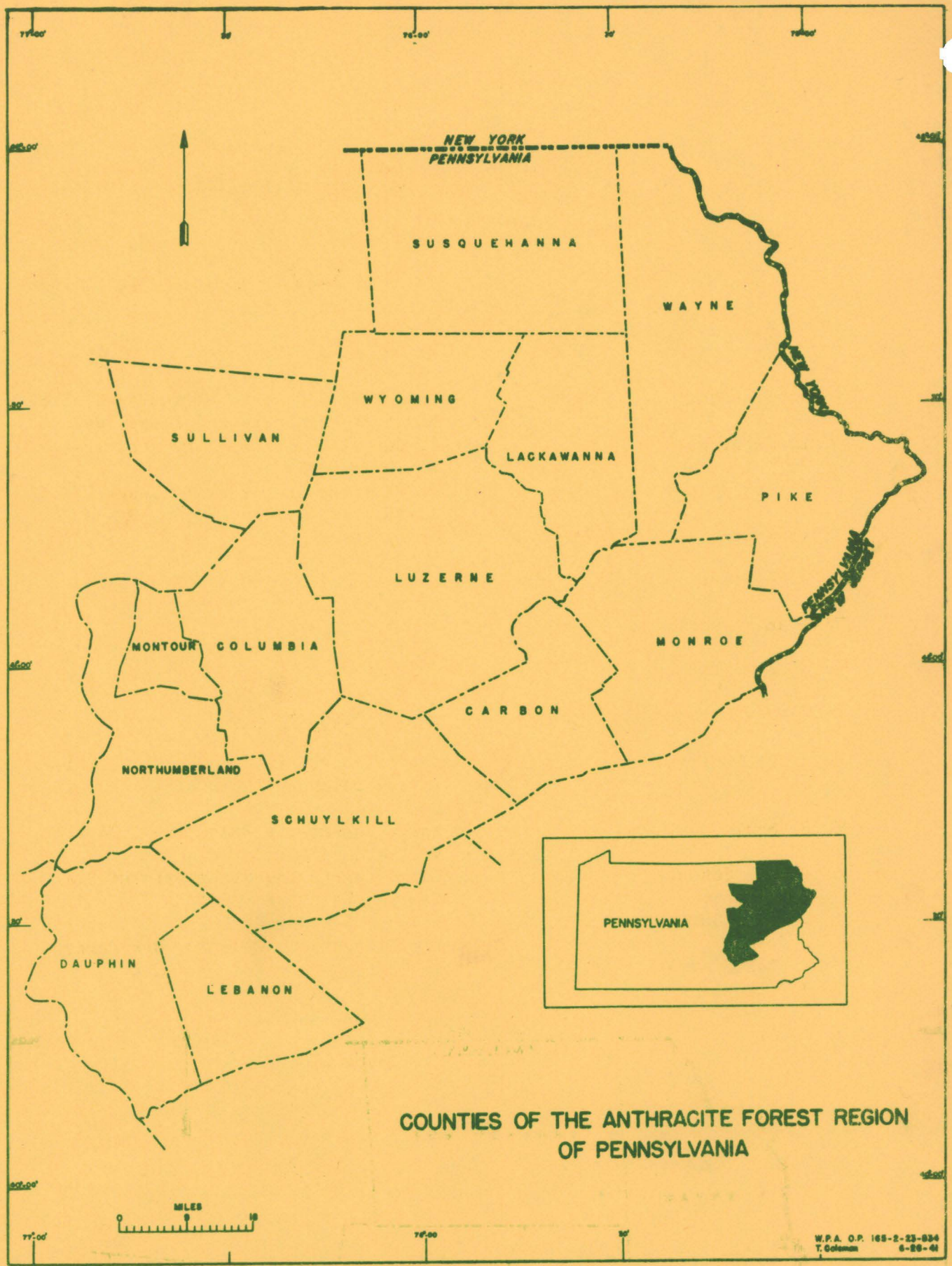

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